ANTI-SLIP STEP FOR A MOTOR VEHICLE AND A METHOD OF FORMING THE SAME

BACKGROUND OF THE INVENTION

The present invention generally relates to steps and more particularly to steps for heavy duty motor vehicles, such as industrial trucks, to facilitate the ingress and egress of operators to and from cabs of the trucks.

Truck steps are conventionally constructed from metal plates having planar support surfaces. Grip structures are typically formed in the support surface to prevent slippage, especially when the step is wet or covered with ice. Drainage holes may also be formed in the metal plate to allow water to drain from the support surface. The grip structures are disposed around openings in the plate and usually have curved side walls defining continuous top rims. While grip structures of this construction will improve the grip of a step, the continuous nature of the top rims can still render the top rims and, thus, the step quite slippery when the step is wet or covered with ice. In order to address this deficiency of conventional grip structures, other grip structures have been developed. Such grip structures are disclosed in U.S. Patent No. 3,181,440 to Mullaney et al. and U.S. Patent No. 4,343,119 to Bahnfleth.

The rosette of the Bahnfleth patent includes a plurality of spaced-apart extensions having arcuate edges. The extensions slope inwardly to provide the rosette with a relatively narrow cross-shaped opening. Although contact portions of the rosette edges are discontinuous in a plane of contact, these contact portions are small. Moreover, the slope of the extensions present major surfaces that are located just below the contact portions. These major surfaces can become slippery when the rosette is wet or covered with ice. Moreover, the narrowness of the opening in the rosette can make the rosette susceptible to clogging with dirt or ice.

The grip structures of the Mullaney et al. patent comprise cylindrical flanges that extend upright from a metal tread plate 14. Top portions of the

flanges are gulleted to provide a number of fairly deep truncated gripping edges. In order to increase the height of the flanges and permit the flanges to extend upright, the flanges are thinned. With the foregoing high-profile construction, the flanges may trap footwear and cause injury if they are not properly spaced apart. For this reason, the Mullaney et al. patent discloses that the flanges must be spaced closely together. Such close spacing, however, may not always be desirable.

Based on the foregoing, there is a need in the art for an improved anti-slip step having low profile grip structures. The present invention is directed to such an anti-slip step.

SUMMARY OF THE INVENTION

In accordance with the present invention, an anti-slip step for a motor vehicle is provided. The step includes a tread plate with a top surface and a bottom surface. A plurality of grip structures extend upwardly from the top surface of the tread plate. Each of the grip structures at least partially defines a hole extending through the tread plate. Each of the grip structures includes a base having a continuous, curved side wall that is joined to the tread plate. A plurality of spaced-apart tabs are joined to the base and extend upwardly therefrom. A plurality of drain structures extend downwardly from the bottom surface of the tread plate. Each of the drain structures at least partially defines a drain hole extending through the tread plate.

In accordance with another feature of the present invention each of the grip structures has a height (H) and the side wall of the base is joined to the tread plate so as to form a radius of curvature (RC) between the base and the top surface of the tread plate, wherein the ratio of the radius of curvature (RC) to the height (H) of the grip structure is greater than 0.5.

Also provided in accordance with the present invention is a method of forming an anti-slip step. Pursuant to the method, a tread plate is provided having top and bottom surfaces. A plurality of holes are formed in the tread plate. For at least one of the holes, a boundary region of the tread plate disposed

around the hole is bent so as to extend out of the plane of the top surface and thereby form a first structure at least partially defining a first opening. For at least another one of the holes, a boundary region disposed around the hole is bent so as to extend out of the plane of the top surface and thereby form a second structure at least partially defining a second opening, wherein the second structure extends a farther distance from the tread plate than the first structure.

BRIEF DESCRIPTION OF THE DRAWINGS

The features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

Fig. 1 is a perspective view of a step;

Fig. 2 is an elevational view of a grip structure in a tread plate of the step;

Fig. 3 is an elevational view of a drain structure in the tread plate of the step;

Fig. 4. is a vertical sectional view of the grip structure;

Fig. 5 is a vertical sectional view of the drain structure;

Fig. 6 is a plan view of a hole in the tread plate from which the grip structure is formed; and

Fig. 7 is a plan view of a hole in the tread plate from which the drain structure is formed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It should be noted that in the detailed description that follows, identical components have the same reference numerals, regardless of whether they are shown in different embodiments of the present invention. It should also be noted that in order to clearly and concisely disclose the present invention, the drawings may not necessarily be to scale and certain features of the invention may be shown in somewhat schematic form.

Referring now to Fig. 1, there is shown a portion of a step 10 embodied in accordance with the present invention. The step 10 is adapted for installation on a motor vehicle, especially an industrial truck having an elevated cab, such as a dump truck or a tractor for pulling a semitrailer. The step 10 includes a support structure 12 that is preferably composed of a metal, such as aluminum. The support structure 12 includes a tread plate 14, a pair of opposing end flanges 16, front flange 18 and a rear flange (not shown). The tread plate 14 is rectangular and includes top and bottom surfaces 22, 24. The end flanges 16 are joined at bends to opposing end portions of the tread plate 14, respectively, and extend downwardly therefrom. Although not shown, the end flanges 16 may have holes formed therein for receiving screws, bolts or other elongated fasteners that may be used to secure the step 10 between side supports of a stair. The front flange 18 and the rear flange are joined at bends to opposing side portions of the tread plate 14, respectively, and extend downwardly therefrom. Each of the front flange 18 and the rear flange has an L-shaped cross-section and includes a downwardly-extending first member 26 joined at a bend to an inwardly-extending second member 28 so as form an interior ledge. In each of the front flange 18 and the rear flange, the first and second members 26, 28 are preferably disposed at least substantially perpendicular to each other. The second members 28 of the front and rear flanges 18, 20 are preferably disposed at least substantially parallel to the tread plate 14. The support structure 12 is preferably formed from a single metal plate by appropriately cutting out the corners of the single plate and appropriately bending front, rear and end portions of the single plate to form the end flanges 16, the front flange 18 and the rear flange, respectively.

A plurality of grip structures 32 and drain structures 34 extend from the tread plate 14 and at least partially define a plurality of grip openings 36 and drain openings 38 in the tread plate 14, respectively. The grip structures 32 extend upwardly from the top surface 22 of the tread plate 14, while the drain structures 34 extend downwardly from the bottom surface 24 of the tread plate 14. The grip structures 32 provide non-continuous gripping to footwear brought into contact with the tread plate 14, while the drain structures 34 facilitate the

drainage of water from the top surface 22 of the tread plate 14 so as to prevent the pooling of water thereon.

Preferably, the grip structures 32 and the drain structures 34 are arranged such that the tread plate 14 has alternating longitudinally-extending rows of grip structures 32 and drain structures 34. In the specific version of the invention disclosed in Fig.1, there is a longitudinal middle row of drain structures 34 disposed between longitudinal front and rear rows of the grip structures 32. It should be appreciated, however, that the present invention is not limited to this particular arrangement of the grip structures 32 and the drain structures 34.

Referring now to Figs. 2 and 4, each of the grip structures 32 comprises a curved base 40 that is joined to the top surface 22 of the tread plate 14. The base 40 preferably comprises a continuous curved side wall. More preferably, the base 40 comprises a frusto-conical side wall. A plurality of tabs 42 are joined to the base 40 and extend upwardly therefrom. The base 40 and each of the tabs 42 have at least substantially the same thickness as the thickness of the tread plate 14. Preferably, each of the tabs 42 has a substantially angular shape, with a pair of non-parallel sides 42a extending downwardly and outwardly from opposing ends of a free top end 42b. Bottom portions of the tabs are 42 integrally joined to top portions of the base 40. The tabs 42 at least partially define the grip opening 36, which has a diameter "D1", as is best shown in Fig. 4. The tabs 42 are spaced apart around the periphery or circumference of the base 40 so as to cooperate with the base 40 to form a plurality of alternating ridges and valleys, wherein the ridges are comprised of the top ends 42b of the tabs 42 and the valleys are comprised of top end portions 40a of the base 40. The sides 42a of the tabs 42 are joined to the top end portions 40a of the base 40 at bends. Both the top ends 42b of the tabs 42 and the top end portions 40a of the base 40 are slightly arcuate in the horizontal direction. Outer and inner edges of both the top ends 42b of the tabs 42 and the top end portions 40a of the base 40 are preferably uniform in height along their lengths. In addition, the top ends 42b of the tabs 42 are substantially horizontally disposed. The top end portions 40a of the base 40, however, slope slightly inward. The top ends 42b of the tabs 42 are

disposed a height "H" above the top surface 22 of the tread plate 14, i.e., each grip structure 32 has a height "H". Preferably, the top end portions 40a of the base 40 have at least substantially the same arcuate length as the top ends 42b of the tabs 42.

In each grip structure 32, the base is joined to the top surface of the tread plate 14 so as to form a radius of curvature RC1 between the base and the top surface, wherein the ratio of the radius of curvature RC1 to the height H1 of the grip structure (i.e., RC1/H) is greater than 0.5, more preferably greater than 0.75, still more preferably greater than 1. In addition, each grip structure is constructed such that the ratio of the height H of the grip structure to the diameter D1 of the grip opening of the grip structure (i.e., H/D1) is less than 0.75, more preferably less than 0.5, still more preferably less than 0.3. Furthermore, the ratio of the height H of each grip structure 32 to the thickness "T" of the tread plate 14 (i.e., H/T) is preferably less than 3, more preferably less than 2. With the foregoing structure, the grip structures 32 have low profiles that do not require the grip structures 32 to be disposed closely together.

Referring now to Figs. 3 and 5, each of the drain structures 34 comprises a plurality of tabs 46 joined to the bottom surface 24 of the tread plate 14 and extending downwardly therefrom. The tabs 46 have at least substantially the same thickness as the thickness of the tread plate 14. Preferably, each of the tabs 46 has a substantially angular shape, with a pair of non-parallel sides 46a extending upwardly and outwardly from opposing ends of a free bottom end 46b. Top portions of the tabs 46 are integrally joined to the bottom surface 24 of the tread plate 14. The tabs 46 at least partially define the drain opening 38, which has a diameter "D2", as best shown in Fig. 5. The bottom ends 46b of the tabs 46 are disposed a distance or depth "Dp" below the bottom surface 24 of the tread plate 14, i.e., each drain structure 34 has a depth "Dp".

In each drain structure 34, each tab 46 is joined to the bottom surface 24 of the tread plate 14 so as to form a radius of curvature RC2 between the tab 46 and the bottom surface 24, wherein the ratio of the radius of curvature RC2 to the depth Dp of the drain structure 34 (i.e., RC2/Dp) is greater than 1, more

preferably greater than 2, still more preferably greater than 3. Preferably, the radius of curvature RC2 of the drain structures 34 is at least substantially the same as the radius of curvature RC1 of the grip structures 32.

The diameter D2 of the drain openings 38 of the drain structures 34 is preferably at least substantially the same as the diameter D1 of the grip openings 36 of the grip structures 32. The depth Dp of the drain structures 34, however, is preferably less than the height H of the grip structures 32. Still more preferably, the ratio of the depth Dp of the drain structures 34 to the height H of the grip structures 32 (Dp/H) is less than 1, more preferably less than 0.75, still more preferably less than 0.5.

In lieu of having the construction described above, the drain structures 34 may have the same structure (with the same dimensions) as the grip structures 32 (except for extending downwardly from the bottom surface 24), wherein the tabs 46 are joined to bases joined to the bottom surface 24.

Preferably, each of the grip structures 32 and each of the drain structures 34 is formed using a punching operation and an embossing operation, wherein in the punching operation, a hole is formed in the tread plate 14, and in the embossing operation, a boundary region of the tread plate 14 around the hole is pushed away from the tread plate 14 so as to extend out of the plane of the tread plate 14, i.e., so as to extend out of the plane of the top surface 22 or the bottom surface 24, as the case may be. The holes for forming the drain structures 34 are similar to the holes for forming the grip structures 32, except the holes for forming the drain structures 34 are about 13% larger than the holes for the grip structures 32 and except for the difference noted below. In another embodiment of the present invention, all of the holes for the grip structures 32 and the drain structures 34 have the same size and configuration.

One of the holes for the grip structures 32, designated with the reference numeral 50, is shown in Fig. 6. The hole 50 is generally star-shaped and is defined by a plurality of interior edges of the tread plate 14 that define tabs 52 that will become the tabs 42 for the grip structure 32. The interior edges of the tread plate 14 include radially-inward first edges 54 and radially-outward second

edges 56, which respectively correspond to the top ends 42b of the tabs 42 and the top end portions 40a of the bases 40. Each of the first and second edges 54, 56 has a slight outward bend (about 8 degrees) to permit the top ends 42b of the tabs 42 and the top end portions 40a of the base 40 to be smoothly formed when the boundary region (designated by the reference numeral 58) of the tread plate 14 around the hole 50 is pushed outward. The boundary region 58 has an outer perimeter 60 shown by a circular dashed line.

One of the holes for the drain structures 34, designated with the reference numeral 62, is shown in Fig. 7. The hole 62 is also generally star-shaped and is defined by a plurality of interior edges of the tread plate 14 that define tabs 64 that will become the tabs 46 for the drain structure 34. The interior edges of the tread plate 14 include radially-inward first edges 66 (which respectively correspond to the bottom ends 46b of the tabs 46) and radially-outward second edges 68. Each of the first and second edges 66, 68 has a slight outward bend (about 10 degrees) to permit the bottom ends 46b of the tabs 46 to be smoothly formed when the boundary region (designated by the reference numeral 70) of the tread plate 14 around the hole 62 is pushed outward. The boundary region 70 has an outer perimeter 72 shown by a circular dashed line.

Once the holes 50, 62 are formed in the tread plate 14, the boundary regions 58, 70 of the tread plate 14 around the holes 50, 62 are contacted by embossing dies on a press and pushed upwardly or downwardly (depending on the arrangement of the press and the support structure 12) to form the grip structures 32 and the drain structures 34. With regard to the hole 50 for a grip structure 32, the boundary region 58 extends radially outward from the second edges 56 to form an annular portion between the second edges 56 and the outer perimeter 60 of the boundary region 58. With regard to the hole 62 for a drain structure 34, the boundary region 70 has a radius about equal to the distance of the second edges 68 from the center of the hole 62. The boundary regions 58 for the holes 50 are determined by the radii of the dies for the grip structures 32, and the boundary regions 70 for the holes 62 are determined by the radii of the dies

for the drain structures 34. The dies for the grip structures 32 have larger radii than the dies for the drain structures 34.

When the dies for the drain structures 34 are aligned with the holes 62 and pressed against the tread plate 14, the dies for the drain structures 34 only contact the tabs 64 and bend them to form the tabs 46 for the drain structures 34, whereas when the dies for the grip structures 32 are aligned with the holes 50 and pressed against the tread plate 14, the dies for the grip structures 32 contact the annular portions of the tread plate 14 disposed radially outward from the second edges 56 and bend them to form the bases 40 for the grip structures 32.

From the foregoing description, it should be appreciated that the step 10 of the present invention is simple to produce, has improved anti-slip features and facilitates the drainage of water from the step 10. The low profile of the grip structures 32 permits the grip structures 32 to be more spread out without increasing the risk of trapping footwear.

While the step 10 is especially adapted for use on an industrial truck having an elevated cab, the step 10 can also be used in other applications, such as on ships, locomotives and on fixed structures, such as elevated industrial walkways.

While the invention has been shown and described with respect to particular embodiments thereof, those embodiments are for the purpose of illustration rather than limitation, and other variations and modifications of the specific embodiments herein described will be apparent to those skilled in the art, all within the intended spirit and scope of the invention. Accordingly, the invention is not to be limited in scope and effect to the specific embodiments herein described, nor in any other way that is inconsistent with the extent to which the progress in the art has been advanced by the invention.